



High-performance by design

55cm FOV.
Hours of continuous scanning.

BlueSeal magnet would not be such a game-changer if it only revolutionized MR operations. In parallel, Philips placed a great deal of emphasis on creating a magnet design that delivers excellent clinical performance. Thanks to highly efficient cooling properties from its micro-cooling system, the BlueSeal magnet does not compromise in performance specifications for homogeneity, homogeneity stability over time, FOV, B0-stability over time. Furthermore, the magnet offers a leading homogeneous field-of-view of 55cm for a 1.5T 70cm system and a wealth of new clinical capabilities that help you answer the most challenging demands.

Question to Philips design expert: How are the clinical properties affected with this new technology based on a fractional amount of Helium?

The resulting magnet performance is amongst the best in the industry, with excellent homogeneity, high gradients linearity and a superb field-of-view. See the specifications below for more details.



mDIXON XD FFE
Compressed SENSE
2.0 x 2.0 x 2.0 mm, 14.4 sec

DWIBS
4.8 x 5.1 x 6.0 mm,
1:57 min /stack

BlueSeal magnet design	
Field strength	1.5T
Magnet design	Ultra compact, lightweight and sealed
Magnet weight (with cryogen)	2,300 kg (5,071 lbs)
Minimum siting limitation	3,700 kg (8,157 lbs)
Open bore diameter	70 cm (incl. shim, gradient & QBC)
Maximum FOV	55 cm x 55 cm x 50 cm

BlueSeal micro-cooling system	
Type of cryogen	Liquid helium (~7 liters)
Micro-cooling technology	Yes
Cryogen boil-off rate	Not applicable, fully sealed
Cryogen refill interval	Not applicable, fully sealed

Vent-pipe requirements	Not applicable, fully sealed
BlueSeal adaptive-intelligence	
Type of magnet controller	Digital, adaptive-intelligent
Self ramp-up unit	Yes, digital
Self ramp-down unit	Yes, digital
BlueSeal EasySwitch	Yes, adaptive-intelligent
EasySwitch innovations	Yes, magnet UPS, air-cooled compressor and 24/7 monitored e-Alert

Did you know?

Worldwide, MRI scanners alone are responsible for **20%** of helium consumption. In the USA, the figure is as high as **31%**.¹

Across vendors, more than **65%** of MRI users experienced a quench in the last 10 years.²

More than **60%** of MRI users had a situation with items stuck to the magnet in the last 3 years.²

After reading about sealed technology, **2 out of 3** customers would prefer an MRI that would not require helium.²

¹ JR Campbell & Associates; USGS
² Marktech June 2017 study

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PHILIPS

BlueSeal magnet



BlueSeal magnet

Transition your department towards more productive helium-free MR operations¹

Based on a decade of innovation, Philips BlueSeal is a fully sealed magnet designed to simplify your MR installation, reduce lengthy and costly disruptions in your MR services, and help your department transition to sustainable helium-free operations. This revolutionary magnet operates with only seven liters of liquid helium and is fully sealed – freeing up your mind and operations from potential helium complications.

With BlueSeal magnet, Philips aims to help MR facilities overcome potential helium-related issues of classic magnet design and eliminate radiology department's dependency on scarce helium supply. What's more, the system can achieve hours of continuous high-performance scanning and offers a leading field-of-view of 55 cm for a wide bore 1.5T system.



¹ Compared to the Ingenia 1.5T ZBO magnet.



Forget about helium

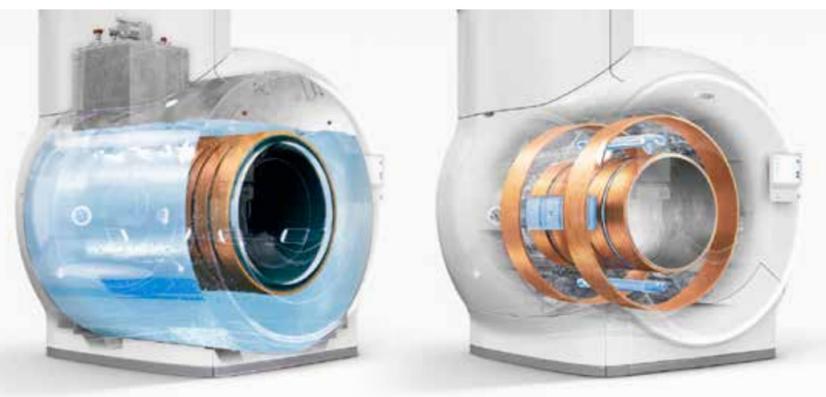
Micro-cooling technology.
Fully sealed.

In contrast to classic magnet technology, which requires around 1,500 liters of liquid helium for cooling during operation, Philips BlueSeal uses highly efficient, new micro-cooling technology that requires only a negligible amount (<0.5% of today's volume¹) of liquid helium for cooling. This fraction of the usual amount of liquid helium is placed in the magnet during manufacturing and then fully sealed, enclosing the precious coolant for the rest of its life. Due to the magnet being sealed, no helium can escape², either suddenly during a loss of field or gradually. This reduces long interruptions to MR services that can result from helium issues. Moreover, it means that the magnet does not have to be refilled with liquid helium during its lifetime, avoiding any cryogenic work on the magnet at your facility.

The magnet coils sit in the vacuum instead of in the helium vessel and are cooled by cooling tubes that are thermally connected to the magnet coils. The helium circulates through gravity and is cooled by the cold head. Cold helium gas is denser and is heavier than warm helium gas. As such, the cold gas sinks downward and moves through the cooling tubes along the superconducting coil section. While taking up heat from this coil, the helium gas warms up slightly, expands and gets lighter. As a consequence, the helium gas goes up and comes in contact with the cold head, where it is cooled. The process then repeats itself.

Question to Philips design expert: If no vent-pipe is needed, how do you provide pressure control?

In case of spontaneous loss of field, the temperature of the superconducting coils increases and the pressure in the cooling system increases to a medium pressure that is fully contained. This pressure is four times lower than the pressure that was used when filled during manufacturing (at room temperature). The magnet is fully designed to accommodate this and meets the ASME and PED standards related to pressurized vessels.



Classic magnet technology
~1,500 liters of liquid helium

BlueSeal micro-cooling technology
~7 liters of liquid helium

¹ Compared to the Ingenia 1.5T ZBO magnet.

² Even in the rare case of the magnet becoming unsealed, the negligible amount of helium escaping would not materially affect the oxygen level within the room.



Designed to facilitate low siting and other construction costs

No vent-pipe. 900 kg lighter¹.



Classic magnet



BlueSeal magnet

The BlueSeal magnet can dramatically reduce installation costs. On a classic magnet with large amounts of liquid helium, long vent pipes must be installed to meet safety requirements and direct helium to an outside vent in case of a magnet quench. With the BlueSeal magnet, no helium can escape due to the magnet being sealed. There is no need for a vent pipe,

significantly reducing construction costs. Philips BlueSeal is also lightweight with a minimum siting limitation of 3,700 kg. This is around 900 kg lighter than its predecessor¹, a decrease in weight that can potentially facilitate easier siting, reduce floor adaptations and further lower construction costs.

Question to Philips design expert: Beyond siting and construction, how can Philips BlueSeal help facilitate on-site safety procedures?

IEC International standard 60601-2-33 describes the particular requirements for the safety of magnetic resonance equipment for medical diagnosis. Since the BlueSeal magnet has a fractional amount of helium contained in a closed cooling system, no helium can escape during a loss of field. As a result, the following IEC requirements do not apply, which helps to simplify on-site safety procedures:

- NO provisions for supply of liquid cryogen, e.g. procedures to be performed after gas release or precautions against lack of oxygen.
- NO safety provisions in the event of a quench, e.g. emergency plan in the event of a quench

¹ Compared to the Ingenia 1.5T ZBO magnet.



Toward uninterrupted MR operations

Adaptive intelligence.
EasySwitch solutions.

With classic MR systems, irrespective of the extreme caution exercised by all MR users, a magnetic item can become stuck in the magnet² requiring a voluntary quench. The magnet can also undergo a sudden involuntary loss of field, which can disrupt a facility's MR services for days to even weeks causing massive revenue loss. The BlueSeal magnet takes the next step toward uninterrupted, more productive¹ daily MR operations. Relying on unique digital controllers and 24/7 e-Alerts connectivity³, the BlueSeal magnet qualifies as the first magnet driven by adaptive intelligence to support a set of unique service functionalities called EasySwitch. The EasySwitch solutions aim to minimize unexpected downtime in case of MR operational issue.

Designed to minimize unexpected downtime in case of item stuck in the bore

The BlueSeal's magnetic field can be easily

turned off from the console if an item becomes stuck in the bore. Once the problem is resolved, a Philips engineer⁴ can initiate an automated re-energize and bring the magnet back to field, minimizing operational downtime.

Designed to minimize unexpected downtime in case of chiller failure

The magnet has both a water-cooled compressor and an air-cooled compressor. The air-cooled compressor is used as a back-up when there is no cold water supply. In case of a chiller failure, the BlueSeal magnet's adaptive intelligence will switch to the air-cooled compressor and switch back again when the cooling water supply is restored. E-Alerts are used to monitor the water-cooled compressor and many other components 24/7, so you and Philips Remote Services know about a potential problem even before it occurs and can minimize the potential downtime of your system.

Question to Philips design expert: In case of patient emergency, how long does it take to ramp the magnet down? How different is it from a controlled ramp-down?

In case of a patient emergency, the system will ramp-down immediately after pushing the Emergency Ramp Down Unit button (ERDU). The table below describes the two different ways of ramping the BlueSeal magnet down and up.

Type of ramp-down	Controlled ramp-down in case an object is stuck in the bore (injector, cleaning tool, etc.)	Emergency ramp-down In case of a patient emergency
Conditions to ramp-down	Philips engineer from the operator console	Technologist upon the push of the ERDU button
Timing	<ul style="list-style-type: none"> • About 1 hour to ramp-down • <24 hours to be back to operations (typically 1 to 2 working days)⁵ 	<ul style="list-style-type: none"> • Immediate ramp-down • < 3 days to be back in operation
What happens in the cooling system?	<ul style="list-style-type: none"> • All helium moves to gas state and remains contained in the fully sealed cooling system • Helium gas remains cold 	<ul style="list-style-type: none"> • All helium moves to gas state and remains contained in the fully sealed cooling system • Helium gets warmer. The cryo-compressor will cool down the magnet to <4K.

² Marketech June 2017 study (across vendors) showed that 69% of U.S. respondents and 93% of German respondents experienced at least one event where an item became stuck in the magnet within the last 3 years.

³ Requires remote connectivity.

⁴ Requires appropriate service contract.

⁵ Subject to service contract and site conditions. BlueSeal can be brought off field and back to operations in less than 16 hours, including automatic ramp-down, cool-down time, ramp-up time, shim check, calibrations, verifications (based on internal testing). The magnet may need shimming after a controlled ramp-down.